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EFFECT OF EXTRINSIC REWARDS ON MOTIVATION.

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*REWARDS, *MOTIVATION, *BEHAVIOR PATTERNS, *CONDITIONED STIMULUS, TRAINING, COLLEGE STUDENTS, STILLWATER, OKLAHOMA

THE SPECIFIC PROBLEM WAS WHETHER HUMANS, AFTER HAVING BEEN TRAINED ON A GIVEN REWARD SCHEDULE TO ACT IN A GIVEN WAY IN GIVEN CIRCUMSTANCES, WILL EXHIBIT FIXED EXTINCTION BEHAVIOR REGARDLESS OF THE DIFFERENCES BETWEEN THE TRAINING AND THE EXTINCTION PERIODS. SUBJECTS WERE 360 COLLEGE STUDENTS WHO HAD VOLUNTEERED FOR THE EXPERIMENT. AN APPARATUS WAS USED THAT FED BB'S WHEN A KNOB WAS PULLED AND THE BB'S ACTED AS THE REWARDS. A PROGRAMER FED THE BB'S ON A SET VARIABLE RATIO REINFORCEMENT SCHEDULE. THE HYPOTHESIS THAT EXTINCTION BEHAVIOR WOULD BE RELATED TO THE AMOUNT OF REWARD WAS SUPPORTED, ALTHOUGH THE CIRCUMSTANCES WERE SUCH AS TO CAST SOME DOUBT UPON IT. IN THE LIGHT OF THE LITERATURE ON THE RELATIONSHIP BETWEEN REWARD AND BEHAVIOR IT MIGHT BE INTERESTING TO PURSUE THIS FINDING FURTHER. (JL)

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EFFECT OF EXTRINSIC REWARDS ON MOTIVATION

Cooperative Research Project No. 5-8164-~~2-12~~-1

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Oklahoma State University
Stillwater, Oklahoma
1966

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EXPERIMENT I

PROBLEM

This experiment and the second, described below, grew out of the attempt to state the principles (as distinct from theory) derived from the behavioristic literature on learning in a form suitable for teachers. In the pursuit of this end the general problem arises that, in contrast with the animals used to develop the principles, school children have learned a great deal and, whether as a result of that learning or as a result of inherent cognitive abilities, they can and do act in an apparently logical fashion. Since this is so, it should be possible to make more accurate predictions of human behavior than is possible with a probabilistic approach.

One of the specific problems is whether humans, after having been trained on a given reward schedule to act in a given way in given circumstances, will exhibit fixed extinction behavior regardless of the differences between the training and the extinction periods. If they do not, then more accurate knowledge of how they are likely to act in given extinction situations should enable teachers to predict the behavior of students more accurately. Thus two problems are involved; conceptualizing the situations and describing the behavior in those situations.

At another level the experiment is a gesture in the direction of rapprochement between behavioristic and cognitive theories on the assumption that humans learn and act in accord with behavioristic principles at first but cognitively later. If such rapprochement can be achieved it might be possible to combine the experimental rigor of behavioristic psychology with the hypothesis potential of cognitive psychology.

HYPOTHESES

The hypotheses were:

1. Extinction behavior is a function of the amount of change between the learning and extinction conditions when change is defined in physical terms.

2. The amount of reward affects extinction behavior.

3. Perception of emptiness of the reward reservoir affects extinction behavior

   a. as detected by normal parametric statistics.

   b. in a way which demands a cognitive rather than a probability explanation.

   c. in interaction with the amount of incentive.

RELATED RESEARCH

The ideas which generated these experiments, or are pertinent to them, come from a number of sources. Tolman initiated the literature on non-response extinction which is reviewed by Kimble (1961) and commented upon by Gladstone (1966). Kimble concludes that non-response extinction does occur. Gladstone's (1966) results are consonant with that conclusion. He found that, when college students were able to see the rewards empty out of a reservoir and the empty reservoir, their behavior in the extinction situation differed from that of students who could not see the rewards. However, the behavior of the Ss who could see the rewards could not be described with assurance as rational; i.e. while some Ss stopped abruptly when the last reward fell from the reservoir, many did not. Gladstone also found that sex made no significant difference in these results.

Ferster and Skinner (1957) show that extinction is a function of the

reinforcement schedule. Perception and significance are totally ignored. Bitterman et al. (1953) in a study based upon the work of Mowrer and Jones (1945) state the assumption that ". . . the rate of extinction is inversely related to the similarity between conditions of training and extinction." They go on to show that their results can be explained by this "discrimination hypothesis" while the concept of secondary reinforcement cannot explain them.

Piaget (as described in Hunt, 1961) attempts to show that cognitive behavior is a function of the growth process having early stages described in terms similar to those of behavioristic theory. Harlow (1949) shows that insightful behavior has its roots in trial and error behavior.

PROCEDURE

Equipment. The equipment consisted of (1) a rat pellet feeder with 10 BBs substituted for pellets; (2) a knob which was pulled in order to operate the feeder; (3) a programer which fed the BBs on a set variable ratio reinforcement schedule; and (4) a light. The feeder had two covers, one opaque, the other transparent so that the rewards were either visible or invisible. The light could be set to go on or not to go on when the last BB was released. Ss were paid for each BB as described below. Extinction Rs were recorded by a counter.

Conditions. There were 3 conditions. One was the normal extinction condition in which Ss could not tell when they had received the last reward, i.e., were being subjected to extinction conditions. Another used the same condition changed only by the fact that a light went on when the last reward dropped from the reservoir. The third was one in which the BBs (token rewards) were visible. (The last possibility, visible BBs with light, was not used.) These conditions are referred to as the invisible, invisible-with-light, and visible conditions respectively.

Contrasting the results of the invisible condition with the invisible-with-light condition enables a partial test of the Bitterman et al. (1953) hypothesis that extinction rate is a function of similarity between training and extinction conditions. A more adequate test would involve a parametric study. Contrasting the visible condition with each invisible condition enables a test of the effect of the perception of emptiness.

Four incentive conditions were imposed on each of the stimulus (equipment) conditions. In one group each S was given 1¢ for each BB, in one group they received 5¢, in one 10¢, and in one 15¢. The 15¢ group had the additional condition imposed that 1¢ was subtracted for each R thus giving them an incentive not to give extinction Rs.

An outline of the experimental design appears in Table 1.

Subjects: Subjects were 360 college students who volunteered for the experiment, 10 in each cell.

Subject-equipment interaction. The nature of the equipment was such that it was difficult to stop responding at the time the last BB fell. The effect of this difficulty was assessed by requesting 30 Ss to respond at a normal speed for them but to stop as soon as the last BB fell. The same Ss were used for this purpose as were used to get the main experimental data after having completed the main task.

The average number of extinction Rs was 1.2. Four Ss yielded 4 extinction Rs with 3 yielding 3. This means that even when the typical S intended to stop at a given point he was unable to do so. This can be interpreted in terms of physiological response time and in terms of the fact that it took time for the BB to fall and strike the dish with a clatter thus completing the entire signal.

Procedure: Ss signed up for a specific time. At the time a given S arrived at the experimental room the apparatus was set for a given stimulus

condition. The next S found a different stimulus condition, the third found a third stimulus condition, the fourth found the first stimulus condition, etc. All the data for the 1¢ incentive condition were collected before going to the 5¢ condition. The 5¢ condition being completed, the 15¢ (gambling) condition was used followed by the 10¢ condition. The incentive conditions were not randomized because it was feared that a 1¢ S following a 10¢ S might feel put upon. Ss were requested not to discuss the experiment with anyone else but there was no way of being sure that this prohibition was heeded.

Directions: The following directions were given to the E operating the equipment for the 5¢ incentive conditions:

> Ss will report to secretaries. Secretaries will ask name of E (Gladstone). Secretaries then request S to be seated in hall until called.

Procedures: The subjects in each group will be taken one at a time to the experimental room where they will stand in front of the apparatus and be given the following instructions:

"There are no tricks in this experiment. Everything is just as it appears to be. We are trying to see how far down in the age scale we must go before people start to act in a way which doesn't make any sense. We expect you to act sensibly. Just follow the direction in a way which makes sense to you."

"Your task in this experiment will be to operate this machine. Here is how it works. Pull this plunger out and push it in and a small BB will drop into this cup, like this (experimentor demonstrates). Later you will be given a nickle for every BB you have. Do you understand what you are to do?" (E may repeat the essential instructions but questions as to the nature of the experiment will be answered pleasantly with the phrase "I am not allowed to tell

you any more about the experiment. Just act as sensibly as you can.")

"You may start now. Please tell me when you are through." (E responds to S's question of, "Can I stop now?" with, "It's up to you.") When S says he is through, E will give the reward to S in exchange for the number of BB's in the reward cup. If S obviously has stopped but does not say so, say, "Are you through?" If S indicates he is, give him the reward.

E asks S why he stopped responding and records S's answer. Say, "Please do not discuss this experiment with anyone else."

For the 1¢, 10¢ and 15¢ groups the appropriate word was substituted for "nickel." The 15¢ Ss were also told that 1¢ would be taken away each time they pulled the knob.

Findings and Analysis of Data

Because the characteristics of the individual data are important, Table 1 gives them all. Since all the calculations can be carried out by reference to Table 1, no results of calculations will be given except those used directly. Table 2 gives the pertinent means and the least differences between them significant at the 5% level.

Actually, the data were dealt with in two ways as a result of the skewing resulting from the high scores. A normal analysis of variance was carried out and is used here. In addition, the data were reduced to ranks and dealt with by analysis of variance. The two sets of results were very similar.

While the skewing did not appear to affect the analysis of variance, the fact that two separate populations seem to be involved, (one clustered in a reasonably normal way in the range 0-60, the other quite large and scattered widely and unpredictably, reaching toward some unknown upper limit) may well affect the interpretation of the results of the analysis.

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Insofar as the means are concerned, there are significant differences between the invisible conditions and the other two but none between the invisible with light vs. the visible conditions. This supports the discrimination hypothesis as stated by Bitterman, et al. and undercuts the rationality hypothesis.

Going on to an examination of the incentive means, the 1¢ and 15¢ conditions each differ from each of the 5¢ and 10¢ conditions. Keeping in mind the fact that the 15¢ condition uniquely included the gambling condition, the difference involving the 1¢ incentive seems to suggest that the 5¢ and 10¢ incentives tend to maintain extinction behavior longer than 1¢ and that the larger incentives do not vary in this respect. However, keeping in mind the "two populations" hypothesis stated above, a glance at the data suggests that the 1¢ condition simply failed to get enough high scorers (second population) and this accident caused the difference.

However, the results are consonant with the literature on the effect of size of reward on extinction behavior.

It is possible to interpret the 15¢ mean in either a behavioristic or cognitive framework. It is possible to suggest (although hard to believe) that the relationship between amount of incentive and extinction Rs has an inverted U shape. A cognitive explanation, on the other hand, must utilize a self-imposed goal interacting with an assessment of the significance of cues. The latter hypothesis suffers from the lack of significance of the difference between the 1¢ and the 15¢ means. It suffers further from the lack of significance of the differences between the 15¢-visible mean and 9 of 11 of the rest of the means as discussed below.

Examining the body of Table 2, there are significant differences but the pattern of the differences makes no sense suggesting that the significance of the differences are a function of chance factors, perhaps of the hypothesized

TABLE 1

Extinction Rs*

1¢ Incentive			5¢ Incentive			10¢ Incentive			15¢ Incentive Gambling		
Invisible	Invisible with light	Visible	Invisible	Invisible with light	Visible	Invisible	Invisible with light	Visible	Invisible	Invisible with light	Visible
38	23	31	331	15	27	108	42	4	49	20	0
25	9	3	143	8	7	10	99	729+	27	13	11
46	5	0	443+	5	15	13	165	36	45	5	0
5	14	14	449+	404+	79	33	67	14	13	5	1
150	35	37	337+	6	1	29	39	0	40	25	1
458+	8	28	496+	45	1	28	19	629	158	13	1
26	25	5	47	42	2	320	334	0	8	17	0
59	1	20	107	113	2	104	14	15	12	11	7
23	10	172	150	53	5	18	31	3	16	9	1
23	30	1	39	25	33	234+	14	23	21	6	14

*A "+" after a number means S was stopped by E at the end of 4 minutes.

TABLE 2

Means and Least Significant Differences (LSD)

Incentive Conditions	Stimulus Conditions			Incentive Means
	Invisible	Invisible-With-Light	Visible	
1¢	85.30	16.00	31.10	44.13
5¢	254.20	71.60	17.20	114.33
10¢	89.70	82.40	145.30	105.80
15¢	38.90	12.40	3.60	18.30
Stimulus Means	117.02	45.60	49.30	

LSD (5%) between

stimulus means = 53.3

incentive means = 61.0

any two means = 105.7

two populations. The 15¢-visible mean is smallest but not significantly so in sensible ways.

The cognitive hypothesis would be proven in its least ambiguous form if (1) the visible condition yielded fewer extinction Rs than either of the other stimulus conditions thus indicating that the logical nature of the cue was being used; (2) if the gambling (15¢) mean were smaller than any other incentive mean indicating that gambling makes a difference as well as the cue; and (3) if the gambling-visible mean were smaller than all the other visible means. The first of these is validated by parametric statistics, the second and third are true but not significantly so when assessed through the use of classical parametric statistics.

Despite the secure position of classical statistical procedures it is possible to suggest that logical processes, yielding as they do true-not true answers rather than probability distributions, are handled better by techniques other than those rooted in parametric assumptions. Possibly no statistical technique can handle the results of logic and inspection must be used.

It seems reasonable to suggest that chi-square would be a suitable statistic since it is designed to deal with a dichotomy. In this case, however, the data yield results which violate the assumption of chi-square that a number of cases will be represented in every cell. This can be seen by an inspection of Tables 3, 4, and 5.

In these tables the dichotomy is logical vs. non-logical behavior where logical behavior is defined by a number of extinction Rs equal to or less than two. When this analysis is carried out one or more cells must have very few cases since S cannot act rationally without the information which would make it possible. Similarly, if rational behavior is possible and S is sufficiently motivated it is possible to hypothesize that very few Ss would not so act. Nevertheless, the analysis is carried out just to see what happens.

An inspection of Table 3 makes it obvious that something is going on in the visible column which is different and the 15¢-visible figure stands out sharply. Table 4, testing the difference between the visible vs. the two invisible conditions yields a chi-square of 27.77 where the .05 level is 3.84 and the .01 level is 6.64. Thus chi-square points up the difference much more sharply than the parametric test.

Table 5 deals with the logical vs. the discriminative hypotheses, a difference which, with parametric statistics, was not significant. The chi-square is 13.8.

Table 6 deals with the difference between the logical-possible only condition (visible-1¢) vs. the logical-possible plus incentive condition (visible-15¢), a comparison which was not significant using parametric statistics. The chi-square is 4.5, significant at the .05 level.

In the light of these differences it seems legitimate to hypothesize that chi-square is more adequate for this particular task.

CONCLUSIONS

1. The Bitterman et al. discrimination hypothesis is supported. The intrusion of new stimuli at the time extinction procedures begin will reduce the number of extinction Rs in the classical extinction condition.

2. The hypothesis that extinction behavior would be related to the amount of reward was supported, although the circumstances were such as to cast some doubt upon it. In the light of the literature on the relationship between reward and behavior it might be interesting to pursue this finding further.

3. While parametric statistics do not detect the difference in response during extinction between the invisible-with-light and the visible condition, chi-square points up a massive difference when the criterion is logic-based

TABLE 3

Rs in Visible vs. Other Conditions

	≤2			>2		
	Invisible	Invisible with light	Visible	Invisible	Invisible with light	Visible
1¢	0	1	2	10	9	8
5¢	0	0	4	10	10	6
10¢	0	0	1 *	10	10	9
15¢	0	0	7	10	10	3

*Should be 2. Changes results but not ultimate conclusions.

TABLE 4

Visible vs. Other Conditions

	≤2	>2
Invisible + Invisible with Light	(10 est.) 1 actual	(70 est.) 79 actual
Visible	(5 est.) 14 actual	(35 est.) 26 actual

TABLE 5

Visible vs. Invisible-with-light Conditions

	≤2	>2
Invisible-with-light	(7.5 est.) 1 actual	(32.5 est.) 39 actual
Visible	(7.5 est.) 14 actual	(32.5 est.) 26 actual

TABLE 6

1ç Visible vs. 15ç Visible

	≤2	>2
1ç Visible	(4.5 est.) 2 actual	(6.5 est.) 8 actual
15ç Visible	(4.5 est.) 7 actual	(6.5 est.) 3 actual

behavior. Similarly, parametric statistics do not differentiate as well between the 15¢ visible condition and the other visible conditions. It is suggested that chi-square may be more sensitive as well as logically better for this type of data. It is further concluded that both the significance of cue and fear of loss are reflected in these data.

4. It is suggested that two distinct populations are represented in these data. It would be interesting to attempt to measure personality differences in the two populations.

5. It is possible that a very short extinction period might make the parametric analysis more stable and sensitive.

Experiment II

Problem

The discussion of the general problem under Experiment I is valid. This experiment was carried out primarily because a small pilot study had indicated that children of ages 5-6 tend to stop responding abruptly when the last BB falls in the open (visible) condition but those of ages 2-3 tend to continue. This finding suggests that rational behavior of the type under investigation here is a function of age with an inflection point between 3 and 5 years of age.

Hypotheses

The hypotheses are:

1. Perception of emptiness of the reward reservoir affects extinction behavior
   a. as detected by normal parametric statistics
   b. in a way which demands a cognitive rather than a probability explanation
   c. in interaction with
      1. chronological age
      2. mental age
2. More extinction Rs will result in this age group if Ss receive a reward promptly for each token rather than receiving rewards later for accumulated tokens.

Related Research

The review of literature given in Experiment I is pertinent. The pilot study referred to above is also pertinent.

Procedure

Equipment The equipment of Experiment I was used except that a telegraph key was substituted for the knob since the knob was judged to have too stiff a spring for this group.

Test The Ammons and Ammons "Quick Test" was used to measure the MA.

Conditions Only the visible and invisible conditions of the first experiment were used. Two sets of directions (see below) were used.

The experimental conditions were rotated as follows: the visible and invisible conditions were alternated while the directions were changed for every second S at first. Regardless of the age, Ss were at first assigned to the condition which was set up when they came in. This resulted in age imbalances in the cells. Later, Ss of given ages were selected and subjected to particular conditions in order to equalize the number in some cells and to increase the number in the open condition after it seemed evident that Ss across the age range used were reacting in the normal way to the invisible extinction situation.

Subjects Subjects were children ranging in age from 2½ to 5½ years of age. Most were found through the use of census data. Many of the older Ss were taken from a private nursery school.

Subject-equipment interaction The discussion of the difficulty inherent in stopping on cue is valid for this experiment also although no data were collected. It is estimated that it would probably be even harder to stop on cue using the telegraph key since the key worked more easily and could be manipulated faster than the knob.

Directions The two sets of directions are reproduced below:

CHILDREN'S DIRECTIONS

Group I

"Do you see all these prizes here? In this dish we have some pennies (pause) in this dish we have some little toys (pause) and in this dish we have some gum. Would you like to have some of these

prizes? (indicate all the dishes) All right, you can get some.

I will give you your choice of one of these prizes when you get a BB out of this machine (point to BBs). Each time you get a BB I will let you take one of whatever you want. Now can you tell me how you get prizes?" If he knows, say "Good," if not, explain further.

"All right, here is how you get the BBs. Press this clicker here and pretty soon a BB will drop into this tray. Like this. See, now you have one BB. Which prize would you like to have for your BB?" (Give him prize he selects). "All right, now you do it. Tell me when you are finished pressing the clicker."

With each BB ask him to choose a prize. If he stops without saying anything say, "Would you like to go on or are you finished pressing the clicker?" When he says he is finished ask him why he stopped.

CHILDREN'S DIRECTIONS

Group 2

"Do you see all these prizes here? In this dish we have some pennies (pause) in this dish we have some little toys (pause) and in this dish we have some gum. Would you like to have some of these prizes (indicate all the dishes)? All right, you can get some."

"When you get some BBs out of this machine (point to BBs) I will let you select one prize for each BB you get. So if you get 3 BBs, you will get 3 prizes. If you get 4 BBs you will get 4 prizes. Now can you tell me how you get prizes?" If he knows, say, "Good," if not, explain further.

"All right, here is how you get the BBs. Press this clicker here

and pretty soon a BB will drop into this tray. Like this. See, now you have one BB. All right, now you do it. Tell me when you are through and I will let you choose a prize for each BB you have."

If he stops before all the BBs are gone, trade in the BBs and say, "Are you all done now or would you like to press the clicker some more?" If he stops after all the BBs are gone without saying anything, say "Are you all done now or would you like to press the clicker some more?" When he says he is finished ask him why he stopped.

Findings and Analysis of Data

Most of the work was done with the chronological age data. These data were organized as indicated in Table 1. The number of extinction Rs for each S is entered in the appropriate cell. As a result of the difficulties inherent in getting suitable subjects, the Ns in the cells are uneven. As a result of the fact that more interest centered in the visible condition than in the invisible condition, more Ss were used in the visible condition than in the invisible condition. In order to get the traditional information, an analysis of variance was carried out. For that purpose the number of Ss in each cell within the two major conditions was equalized. In the invisible condition the first piece of data entered in the cell was used. In the visible condition the first two were used. The results of that analysis appear in Table 2.

Only the difference between the two sets of directions was significant, this at a level approaching but not reaching the .01 level. The first set of directions yielded more extinction responses than the second. Thus the hypothesis is confirmed that children of this age group will yield more extinction Rs if they can turn in their token-rewards promptly for rewards rather than waiting until a group of tokens is accumulated.

In order to get information relating to the original hypotheses, further tests were carried out. Since it was hypothesized that logical behavior might

TABLE 1

Chronological Age	Number of Extinction Rs			
	Invisible Condition		Visible Condition	
	Directions 1	Directions 2	Directions 1	Directions 2
5½	130,157	37	1,1,4	1,1,1
5	125	86	0,1,19	2,3,2,3
4½	72,51	32	0,13,1,52,3	2,1,0
4	62,65	35	6,214	65,1
3½	152	80	60,179,0,19	20,0,1,0
3	24	61	249,44,31	19,23,21
2½	131	3,32	138,58	7,24

TABLE 2

Analysis of Variance

Variable(s)	df	Mean Square
Total	41	
Age (A)	6	3,245.94
Invisible vs. Visible (B)	1	10,230.11
Directions (D)	1	31,872.59*
Age X Invisible vs. Visible (AXB)	6	3,938.08
Age X Directions (AXD)	6	1,950.71
Invisible vs. Visible X Directions (BXD)	1	600.12
AXBXD	6	2,228.63
Error	14	3,957.96

*P<.05

be impaired by a lack of maturity, an inspection of the data was carried out which revealed a sharp inflection, almost a discontinuity, in the visible data at age 4. Keeping in mind the fact that such a point at about that age had been hypothesized, the data were broken into two parts; from ages 2½-3½ and 4½-5½, omitting the data of age 4. These data were handled in two ways. First, a visible vs. invisible analysis was made at the two levels of age. Second, a comparison between age levels within conditions was carried out. This procedure tested the following hypotheses:

1. In the older group the Ss in the visible condition will yield fewer extinction Rs than those in the invisible condition. This implies that, when rational behavior is made possible, older Ss act rationally.
2. In the younger group the Ss in the visible group will not differ significantly from those in the invisible group. This implies that the younger Ss do not use the information available in the visible condition.
3. In the invisible group the older Ss will not differ from the younger. This implies that, in the absence of the information available in the visible situation, both sets of Ss will act in the same way.
4. In the visible group the older Ss will yield fewer extinction Rs than the younger. This implies that the older Ss can and do use the information available in the visible situation while younger Ss do not, for whatever reason.

For purposes of testing these hypotheses all the data were used rather than equalizing the number in the cells.

It was recognized that the two sets of tests are interdependent, thus requiring that the P-levels be lowered by some unknown amount before an indication of significance can be trusted, but it seemed reasonable to hope that the differences would be so large that little question could remain.

It is also pertinent to note that a one-tailed test is legitimate for hypotheses 1 and 4. The results appear in Tables 3 and 4. In order to carry out independent tests a new set of Ss would be necessary since there are too few Ss in the group used here to make it possible to split the group randomly in order to conduct independent tests.

TABLE 3

Means of Extinction Rs

Age		Visible Condition	Invisible Condition
Older Ss	N	11	8
	M	5.29 (A)	86.25 (B)
Younger Ss	N	18	7
	M	49.61 (C)	26.83 (D)

TABLE 4

Significance of Differences Between Means[1,2]

Comparison	Hypothesis	Larger M	P-level
A vs. B	1	B	< .01
A vs. C	4	C	< .05
B vs. D	3	B	< .05
D vs. C	2	C	< .05

[1]Tests are not independent and therefore unreliable to some unknown degree.

[2]Using the Cochran and Cox technique for data with unequal variances.

The difference between the means of the older Ss supports hypothesis 1 indicating that the older Ss were able to take advantage of the information inherent in the visible condition. In the light of all the information available and the size of the P-level it seems to be reasonable to accept the hypothesis.

Hypothesis 2 is based upon the assumption that the null hypothesis really is valid in this case. However, the null hypothesis is rejected at a non-conservative .05 level. Furthermore, the difference is in the wrong direction for a cognitive explanation. Actually the results do not appear to make sense within any theoretical system.

Hypothesis 3 again assumes the validity of the null hypothesis. Again the null hypothesis is rejected at the .05 level. Again the test is non-conservative but suggests that it might be profitable to run another experiment to see whether or not older Ss will indeed persist longer than younger Ss in this age range. Actually it does not seem unreasonable to suggest that younger Ss will tire, become bored, or lose hope more easily than older Ss.

Hypothesis 4 is left in a similar state of limbo by a P-level at .05 but the difference certainly suggests the desirability of further investigation.

The number of extinction Rs less than 2 in the various groups is indicated in Table 5. In the light of the small N and the zero in two cells a statistical test is not suitable. However, it is worth noting that the pattern in the visible condition is strongly reversed from young to old and that all the rational Rs appear in the visible condition.

Finally, in order to test whether or not mental age is related more closely to rational behavior in this situation and this age range than chronological age, correlations were calculated between CA and extinction Rs in the visible group and between MA and extinction Rs in the visible group.

TABLE 5

Number of Ss exhibiting rational (extinction R≤2) vs. non-rational extinction behavior

	Visible Condition		Invisible Condition	
	Young	Old	Young	Old
≤ 2	4	14	0	0
> 2	14	7	7	8

The test is crude in the light of the fact that the discontinuity exists, the MA range was larger than the CA range, the difficulties inherent in testing MA in this group, and the fact that there were fewer Ss in the MA array than in the CA array since a number of Ss refused to cooperate. Nevertheless, it is the best test available. The results are summarized in Table 6.

Table 6

Correlations: Age with Rs

		Directions 1		Directions 2	
		CA	MA	CA	MA
Visible Condition	N	22	18	21	20
	r	-.52*	-.47*	-.40	.14
Invisible Condition	N	10	8	8	7
	r	.30	.53	.33	.39

*Significant at the 5% level.

Correlations were calculated primarily to discover whether CA or MA would be a better indicator of the decrement in rationality with decreasing age. The correlations of the visible condition suggest that there is no advantage in using the more complex MA rather than CA for the purpose.

Correlations in the closed condition were calculated out of simple curiosity. They contain no surprises.

CONCLUSIONS

1. The older Ss in the group could and did take advantage of the information available in the visible condition.

2. It is possible that older Ss persist longer than younger Ss in this age group and with this equipment in the classical extinction condition.

3. The young Ss do not act as rationally as the older Ss. The contingency table bolsters the parametric analysis in this case.

4. Again the logical-non-parametric array seems to hold promise of more sensitivity for analyses of this type than the parametric.

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